

1c584 U.S. PTO
06/22/99

Practitioner's Docket No. 442-008702-US(PAR)

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

1c551 U.S. PTO
09/337916
06/22/99

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of
Inventor(s): Ari HOURUNRANTA, Miska HANNUKSELA

WARNING: 37 C.F.R. § 1.41(a)(1) points out:

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors."

For (title): ERROR DETECTION IN RECEIVING MULTIPLEX SIGNALS

CERTIFICATION UNDER 37 C.F.R. 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date June 22, 1999 in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL336859562US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Elaine Mian

(type or print name of person mailing paper)

Elaine Mian

Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(Application Transmittal [4-1]—page 1 of 11)

562299 9164360

1. Type of Application

This new application is for a(n)

(check one applicable item below)

- ☒ Original (nonprovisional)
- ☐ Design
- ☐ Plant

WARNING: Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.

WARNING: Do not use this transmittal for the filing of a provisional application.

NOTE: If one of the following 3 items apply, then complete and attach **ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED** and a **NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION**.

- ☐ Divisional.
- ☐ Continuation.
- ☐ Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 119(e), 120, or 121)

NOTE: A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. 112. Each prior application must also be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(f) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach **ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED**.

WARNING: If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.

WARNING: When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).

- ☐ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

16 Pages of specification

3 Pages of claims

4 Sheets of drawing

WARNING: DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 CFR 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. 1.84(c)).

(complete the following, if applicable)

- ☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. 1.84(b).

☐ formal

☐ informal

B. Other Papers Enclosed

5 Pages of declaration and power of attorney

1 Pages of abstract

 Other

4. Additional papers enclosed

☐ Amendment to claims

☐ Cancel in this applications claims _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)

☐ Preliminary Amendment

☒ Information Disclosure Statement (37 C.F.R. 1.98)

☒ Form PTO-1449 (PTO/SB/08A and 08B)

☒ Citations

- ☐ Declaration of Biological Deposit
- ☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
- ☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative
- ☐ Special Comments
- ☐ Other

5. Declaration or oath (including power of attorney)

NOTE: A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)-(3).

NOTE: A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)-(4).

☒ Enclosed

Executed by

(check all applicable boxes)

- ☒ inventor(s).
- ☐ legal representative of inventor(s).
37 CFR 1.42 or 1.43.
- ☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. See item 13 below for fee.

☐ Not Enclosed.

NOTE: Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

☐ Application is made by a person authorized under 37 C.F.R. 1.41(c) on behalf of all the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 CFR 1.16(e) can be filed subsequently).

☐ Showing that the filing is authorized.
(not required unless called into question. 37 CFR 1.41(d))

6. Inventorship Statement

WARNING: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of \$130.00 required by 37 CFR 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 CFR 1.52(c).

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. 1.52(d).

8. Assignment

☒ An assignment of the invention to Nokia Mobile Phones Limited

☒ is attached. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters—one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: A newly executed "CERTIFICATE UNDER 37 CFR 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

(Application Transmittal [4-1]—page 5 of 11)

9. Certified Copy

Certified copy(ies) of application(s)

Country Finland	Appln. No. 981507	Filed June 30, 1998
Country	Appln. No.	Filed
Country	Appln. No.	Filed

from which priority is claimed

☒ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 CFR 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. 1.16)

A. ☒ Regular application

CLAIMS AS FILED			
Number filed	Number Extra	Rate	Basic Fee 37 C.F.R. 1.16(a) \$760.00
Total			
Claims (37 CFR 1.16(c)) 13 - 20 = 0	×	\$ 18.00	
Independent			
Claims (37 CFR 1.16(b)) 3 - 3 = 0	×	\$ 78.00	
Multiple dependent claim(s), if any (37 CFR 1.16(d))	+	\$ 260.00	

☐ Amendment cancelling extra claims is enclosed.

☐ Amendment deleting multiple-dependencies is enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 CFR 1.16(d).

Filing Fee Calculation

\$ 760.00

B. ☐ Design application
(\$ 310.00—37 CFR 1.16(f))

Filing Fee Calculation

\$ _____

C. ☐ Plant application
(\$ 480.00—37 CFR 1.16(g))

Filing fee calculation

\$ _____

(Application Transmittal [4-1]—page 6 of 11)

1870 1871 1872 1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2

- WARNING:** "Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(c)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.23(a)(2).

☐ Status as a small entity was claimed in prior application
_____ / _____, filed on _____, from which benefit
is being claimed for this application under:

and which status as a small entity is still proper and desired.

- Filing Fee Calculation (50% of A, B or C above)

SA _____

NOTE: Any excess of the full fee paid will be refunded if small entity status is established and a refund request is filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 CFR 1.28(a).

(complete, if applicable)

- (Application Transmittal [4-1]—page 7 of 11)

[illegible]

- NOTE: 37 CFR 1.21(f) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 CFR 1.53(f) and this, as well as the changes to 37 CFR 1.53 and 1.78(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(f) must be paid, within 1 year from notification under § 53(f).

14. Method of Payment of Fees

- A duplicate of this transmittal is attached.

(Application Transmittal [4-1]—page 8 of 11)

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing, the following items should not be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

- ☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 16-1350:

☒ 37 C.F.R. 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☒ 37 C.F.R. 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 C.F.R. §§ 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).

☐ 37 C.F.R. 1.17 (application processing fees)

NOTE: ". . . A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

☐ 37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . ." From the wording of 37 CFR 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

(Application Transmittal [4-1]—page 9 of 11)

652330 "9767660

16. Instructions as to Overpayment

NOTE: "... Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

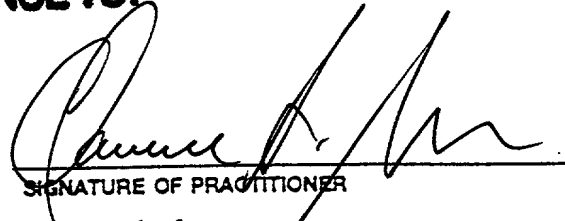
- ☒ Credit Account No. 16-1350
☐ Refund

SEND ALL CORRESPONDENCE TO:

Reg. No. 24,622

Tel. No. (203) 259-1800

Customer No.


SIGNATURE OF PRACTITIONER
Clarence A. Green
(type or print name of attorney)
PERMAN & GREEN, LLP
P.O. Address
425 Post Road
Fairfield, CT 06430

☐ **Incorporation by reference of added pages**

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

- ☐ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

- ☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

- ☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

- ☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

☒ **Statement Where No Further Pages Added**

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

- ☒ This transmittal ends with this page.

ERROR DETECTION IN RECEIVING MULTIPLEX SIGNALS

FIELD OF THE INVENTION

5

The present invention relates to a method , device and system in reception of a multiplex signal, comprising one or more data units, including a video data unit, and at least one framing data block in each multiplex signal, the framing data block carrying information on the configuration of the data units in said multiplex
10 signal. The method comprises searching for said framing data block from a received multiplex signal; demultiplexing said one or more data units according to the information in said framing data block; generating one or more demultiplexed signals, including a video data signal, from said demultiplexed data units, and forwarding said demultiplexed signals for decoding.

15

BACKGROUND OF THE INVENTION

One of the recent targets in telecommunications has been to provide systems, where good quality, real-time transmission of video, audio and data is available. Transmission of video is formed by a continuous stream of data carrying moving
20 pictures. As is generally known, the amount of data needed to transfer pictures is high compared to many other types of media, and so far usage of video in low bit rate terminals has been negligible. Transmission of data in digital form, anyhow, has provided for increased signal to noise ratios and increased information capacity along the transmission channel. In the near future advanced digital
25 mobile telecommunication systems will also be introducing services enhancing the transmission bit rates, which means that transmission of video even over low bit rate mobile channels will soon become more feasible.

30

In circuit switched multimedia transmission, bit streams from sender's different media sources (e.g. video, audio, data and control) are multiplexed into a single bit stream, and at the receiving end the bit stream is again demultiplexed into various multimedia streams to be decoded appropriately. Since the bit streams

from and to different sources are not equal in size, the multiplexing usually also comprises logical framing. This means that the multiplex signal to be transmitted is structured according to a chosen control protocol, and framing data blocks (e.g. bits, flags, etc.) are inserted to identify different data blocks.

5

The basic principle of the multiplexing scheme is illustrated with the block diagram of Figure 1. It is to be noted that the figure merely illustrates the basic concepts and comprises no implications on actual sizes, numbers or order of the transmitted packet. In this example data packets from two different media sources are first multiplexed for transmission and after transmission demultiplexed for forwarding to different decoders. Data packets A1, A2, A3,... from the audio encoder and data packets V1, V2,... from the video encoder are combined in the multiplexer MUX into consecutive packet data units PDU1 (step 1) and PDU2 (step 2). Since video packets V1 and V2 are large, they are broken into segments e.g. V->>V1.1/V1.2 for transmission. The demultiplexer adds a framing data block F to each of the PDUs, to indicate the boundaries and the structure of the contents of the PDUs. In the demultiplexer DMUX, data packets A1, A2, A3,... and V1, V2,... are separated from the PDUs according to the information given in the framing data block F, and forwarded as data signals dA1, dV1,... to relevant decoders. Segmented video data units V1.1/V1.2 will first be combined to single video data packets (e.g. V1), and then forwarded to the video decoder.

For optimization of channel capacity usage, signals are generally compressed before transmission. This is especially important with video transmission, where the amount of data to be transmitted is large. Compressed video, anyhow, is easily afflicted by transmission errors, mainly for two reasons. Firstly, compressed video coding is based on predictive differential coding, in which a sampling system is used and the value of the signal at each sample time is predicted to be a particular linear function of the past values of the quantized signal. This causes propagation of errors, both spatially and temporally, which means that once an error occurs, it is easily visible for the human eye for a relatively long time. Especially susceptible are transmissions at low bit rates, where there are only a

few intra-coded frames, which would stop the temporal propagation. Secondly, information symbols in compressed video are coded mainly using variable length codes, which also increases the susceptibility to errors. When a bit error alters the codeword to another one of different length, the decoder will lose synchronization and also decode consecutive error free blocks incorrectly until the next synchronization code.

To limit the degradations on the images introduced by transmission errors, error detection and/or error correction methods can be applied, retransmissions can be used, and/or effects from the received corrupted data can be concealed. Normally retransmission provides a reasonable way to protect data streams from errors, but big round-trip delays associated with low bit rate transmission and moderate or high error rates make it practically impossible to use retransmission, especially with real-time videophone applications. Error detection and correction methods usually require a large overhead since they add some redundancy to the data. Consequently, for low bit rate applications, error concealing can be considered as a preferred way to protect and recover images from transmission errors.

To be able to conceal transmission errors, they have to be detected and localized. The more is known of the type and the location of the error, the better the concealment method can be focused to the problem, and accordingly the better image quality will be achieved. The video reception process provides different methods of error detection, associated with different protocol layers of video transmission, as illustrated in Figure 2. The channel coding layer 20 provides means for detecting, as well as correcting errors in received bit streams. The transmission protocol layer 22 usually comprises a CRC (Cyclic Redundancy Check) which is run for received video signals, on the basis of which incorrect signals can be rejected. In the video decoding layer 24 errors are usually detected as illegal variable-length codes or incorrectly positioned synchronization codes. Some errors can be detected and corrected even from the decoded images in the picture layer 26. The error concealment method can utilize error data from any or

each of these layers. In this application, anyhow, error detection in the demultiplexing phase is examined with more precision.

For receiving video data, the received synchronous bit stream is forwarded to a demultiplex protocol unit for demultiplexing, logical framing, sequence numbering, error detection and error correction by means of retransmission, as appropriate to each media type. The demultiplexed bit streams are forwarded to appropriate decoders, which carry out redundancy reduction coding and decoding for said demultiplexed bit streams.

The multiplexing protocol for low bit rate multimedia communication over highly error-prone channels is described in ITU-T recommendation H.223. The multiplex consists of a multiplex layer and an adaptation layer. The multiplex layer mixes the various logical channels into a single bit stream. It transfers logical channel information in packets, delimited by a flag. A flag can be a HDLC (High-Level Data Link Control) flag, with which HDLC zero-bit insertion for transparency is also used. It is also possible to use PN framing where the flag is a 16-bit pattern as described in annexes A, B, and C of H.223. Each data packet contains a one-octet header followed by a variable number of information field octets. The header octet includes a multiplex code, which specifies, by reference to a multiplex table, the mapping of the information field octets to various logical channels. Each data packet may contain a different multiplex code, and therefore a different mix of logical channels. The multiplex layer does not perform error control, except for a CRC (Cyclic Redundancy Check) on the header octet.

The adaptation layer handles error control and sequence numbering, as appropriate to each information stream. Specification H.223 defines three adaptation layers AL1, AL2, and AL3, where AL3 is intended primarily for digital video. AL3 includes a 16 bit CRC for error detection, by which the transmission errors can be localized to a single AL3 layer packet. In the specification of the adaptation layers, it is also mentioned that such error indications could be passed

from a video demultiplexer to a video decoder, but actual procedures for implementing such demultiplexer indications are not presented.

5 An indication of the possible error in the received packet is useful in many cases, especially if retransmission is possible. Anyhow, in low bit rate video transmission the amount of information contained in one video packet has to be large in order to limit the amount of bits used for framing and redundancy. This means, that the information about possible errors in the packet *per se* is not very useful, since in many cases by rejecting the whole video packet too much information will be lost
10 which may lead to inadequate picture quality.

SUMMARY OF THE INVENTION

15 It is an object of the present invention to overcome, or at least mitigate the problems encountered in transmission of video over low bit rate channels, and to offer an improved method and apparatus for demultiplexing a received multiplex signal.

20 This object will be achieved by a method according to claim 1 comprising detecting at demultiplexing a possible invalidity of a demultiplexed video data unit; and adding, as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal.

25 Another aspect of the invention is a device according to claim 12 for demultiplexing a multiplex signal, comprising one or more data units, including a video data unit, and at least one framing data block in each multiplex signal, the framing data block carrying information on the configuration of the data units in said multiplex signal. Said device comprises means for searching for said framing data block in a received multiplex signal; means for demultiplexing said one or more data units according to the information in said framing data block; means for
30 generating demultiplexed signals from said demultiplexed data units, means for forwarding said demultiplexed signals for decoding. Said device is characterized in that said device further comprises means for detecting at demultiplexing a

possible invalidity of a demultiplexed video data unit and means for adding, as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal.

- 5 Another aspect of the invention is a multimedia terminal according to claim 13 for demultiplexing a multiplex signal, comprising one or more data units, including a video data unit, and at least one framing data block in each multiplex signal, the framing data block carrying information on the configuration of the data units in said multiplex signal, said device comprising means for searching for said framing data block in a received multiplex signal; means for demultiplexing said one or
10 more data units according to the information in said framing data block; means for generating demultiplexed signals from said demultiplexed data units, and means for forwarding said demultiplexed signals for decoding. Said system is characterized in that said device further comprises means for detecting at demultiplexing possible a invalid invalidity of a demultiplexed video data unit and means for adding, as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal.

15 This and other objects are achieved by checking the validity of demultiplexed video data blocks during the demultiplexing phase. Whenever the demultiplexer detects an error, an error indication is added to the video packet, and preferably an indication of the location of the detected error. The video packet is forwarded to the decoder to be used for further error concealment.

25 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example only, with reference to the accompanying figures, of which:

Figure 1 illustrates the basic principle of the multiplexing scheme (prior art);

Figure 2 illustrates different protocol layers of video transmission (prior art);

30 Figure 3 illustrates a generic H.324 multimedia videophone system (prior art);

Figure 4 shows a protocol stack used in video transmission;

Figure 5 illustrates the principle of the invented method implemented in the demultiplexer of a multimedia terminal;

Figure 6 shows a functional block diagram of a demultiplexer according to the invention;

5 Figure 7 illustrates a configuration of a Protocol Data Unit of AL (AL-PDU);

Figure 8 illustrates an exemplary error detection method for detecting illegal bit combinations; and

Figure 9 illustrates the principle of shifting segments of video data in reception.

10 DETAILED DESCRIPTION

Notwithstanding other forms of the invention, preferred embodiments thereof will be described in connection with, and using the terminology of H.324 and other associated recommendations for multimedia communication terminals. The functional block diagram of Figure 3 illustrates a generic H.324 multimedia videophone system. It consists of a terminal unit 30, a GSTN (General Switched Telephone Network), a modem 31, a GSTN network 32, and a multipoint control unit (MCU) 33. H.324 implementations are not required to have each functional element. Mobile terminals may be implemented with any appropriate wireless interface in place of the V.34 modem (H.324 Annex C).

The MCU 33 works as a bridge, that centrally directs the flow of information in the GSTN network 32 to allow communication among several terminal units 30. The modem 31 converts the synchronous multiplexed bit stream into an analog signal that can be transmitted over the GSTN, and converts the received analog signal into a synchronous bit stream that is sent to the multiplex/demultiplex protocol unit 301 of the terminal 30. The Multiplex protocol multiplexes transmitted video, audio, data and control streams into a single bit stream, and demultiplexes a received bit stream into various multimedia streams. In addition, it performs logical framing, sequence numbering, error detection, and error correction by means of retransmission, as appropriate to each media type. The control protocol 302 of the system control 306 provides end-to-end signaling for operation of the multimedia terminal, and signals all other end-to-end system functions. It provides for

capability exchange, signaling of commands and indications, and messages to open and fully describe the content of logical channels. The data protocols 303 support data applications 307 such as electronic whiteboards, still image transfer, file exchange, database access, audiographics conferencing, remote device control, network protocols etc. The audio codec 304 encodes the audio signal from the audio I/O equipment 308 for transmission, and decodes the encoded audio stream. The decoded audio signal is played using audio I/O equipment. The video codec 305 carries out redundancy reduction coding and decoding for video streams to and from the video I/O equipment 309.

A protocol stack used in video transmission is shown in Figure 4. The multiplexer 301 comprises two distinct layers: a multiplex layer (MUX) 41 and an adaptation layer (AL) 42. The multiplex layer 41 is responsible for transferring information received from the AL to the far end using the services of an underlying physical layer 40. The MUX layer exchanges information with the AL in logical units called MUX-SDUs (Service Data Unit). A MUX-SDU always contains an integral number of octets that belong to a single logical channel. MUX-SDUs typically represent information blocks, whose start and end points mark the location of fields, which need to be interpreted in the receiver. MUX-SDUs are transferred by the MUX layer to the far end in one or more variable-length packets called MUX-PDUs (Packet Data Unit).

The unit of information exchanged between the AL and the higher-layer AL users is an AL-SDU. AL-SDUs contain an integer number of octets. The AL adapts AL-SDUs to the MUX layer by adding, where appropriate, additional octets for purposes such as error detection, sequence numbering and retransmission. The information unit exchanged between peer AL entities is called an AL-PDU. An AL-PDU is conveyed as one MUX-SDU. Three different types of ALs are specified and AL3 is designed primarily for the transfer of digital video. AL3 receives information from its higher layer (e.g. video encoder) in variable length AL-SDUs, and passes these to the MUX layer in MUX-SDUs, after adding two octets for 16-bit CRC, and optionally adding 1 or 2 control octets.

All MUX-PDUs are framed, which means that they are preceded and followed by a flag. At least two different framing flags are used. In HDLC-type framing, the flag consists of a unique bit pattern "01111110". Receivers of packets accommodate receipt of more than one consecutive flag, as the flag may be transmitted repetitively between MUX-PDUs. A transmitter of a packet examines the MUX-PDU content between flags, and inserts a "0" bit after all sequences of five contiguous "1" bits to ensure that a flag is not simulated within the MUX-PDU. The receiver shall examine the received bit stream between the opening and closing flags and shall discard any "0" bit which directly follows a sequence of five contiguous "1" bits. H.223 Annexes A, B, and C give a possibility to replace HDLC framing by PN (not an acronym) framing. In that case, packets are delimited by 16- (or 32) bit patterns. The PN flags are not unique bit patterns, i.e., similar bit patterns can also occur inside the MUX-PDU payload. Since the framing does not change the contents of MUX-PDU, the correct framing flags should be octet aligned, which reduces the probability of fake flag detection.

A MUX-PDU packet contains an octet long header, which comprises a one-bit Packet Marker field (PM) (or a one's complemented synchronization flag in PN framing), a four-bit Multiplex Code field (MC), and a three-bit Header Error Control field (HEC). The MC field specifies to which logical channel each octet of the MUX-PDU information field belongs, and the HEC field provides error detection capabilities over the MC field using a 3-bit CRC. Receivers usually discard MUX-PDUs whose HEC fields fail the error check. H.223 Annex B defines a longer header format for MUX-PDUs, which consists of a 4-bit MC field, 8-bit packet length field, and 12-bit Golay check symbols field. Golay check symbols can be used to detect errors, and even to correct up to 3 bit errors. Since there is no more room for a PM bit in the header, PM is indicated in H.223 Annex B by a one's complemented framing flag.

Using the terms of described prior art, the block diagram of Figure 5 illustrates the principle of the invented method implemented in the demultiplexer of a multimedia

terminal. A more detailed description will be given in connection with following preferred embodiments. Each received data packet is deframed (step 50) i.e. the packet structure is analyzed to find a protocol-specific delimiter (F in Figure 1) used to define boundaries between data blocks. Possible errors encountered during deframing are examined (step 51) and error data indicating the type of found error and estimated location of the error is added to said data packet (step 52). If no errors are detected during deframing, no further error data is added to the data packet.

In the embodiment described herein, the deframing process comprises at least searching for the HDLC flags from the bit stream. According to the invention, the demultiplexer is arranged to recognize certain errors that can be detected during deframing, and conclude the approximate location of erroneous bits. This will be further described in later paragraphs. Whenever such an error is detected, error data indicating the type of the error and the approximate location of erroneous bits is forwarded to the decoder. In the preferred embodiment this is done as side information in the AL-SDU, but other means of indication e.g. inclusion of error indication to the AL-SDU are possible. The decoder is forwarded a packet comprising the following information: video data, length of the packet, error information, error type, and a table of error locations and segment boundaries (the order and content of the error indication can be chosen according to the application). The decoder can then be adapted to utilize this information to recover from transmission errors in the decoding phase.

Figure 6 shows a functional block diagram of a demultiplexer according to the invention. The demultiplexer comprises an input port 60 for receiving a multiplex signal in a transmission channel, and an output port 62 comprising several outputs for forwarding demultiplexed signals to different decoding elements. The demultiplexer also comprises a processor 64 for at least checking the redundancy of the headers of the received multiplex signals, separating data packets associated with different media types, checking the redundancy of the separated data packets, and compiling data signals to be forwarded to the decoder. The

memory 66 comprises at least an volatile memory for saving data during the multiplexing process.

In the following, some methods for checking the validity of the demultiplexed video packet during demultiplexing, and the ways of estimating the location of corresponding erroneous bits, are presented for the described H.223 based embodiment. Further technical details can be found in the ITU-T specification H.223 "Multiplexing protocol for low bit rate multimedia communication". Some methods are based on a search for the HDLC flag and some methods apply both to the HDLC framing and the PN framing. Corresponding error detection methods can, however, be developed for other types of errors as well as for other types of framing protocols. Error detection according to the invention comprises at least one such method, but can consist of any combination of available methods.

In many cases the location of the error is implicitly indicated by the analysis itself, or the location can be derived by analyzing deframing data combined from several contiguous packets. In case the CRC check in AL indicates errors, but the location of erroneous bits cannot be estimated, e.g. because the demultiplexer does not recognize the type of the error which it has detected, a general error indication, e.g. GENERAL_ERROR (not shown) is forwarded to the decoder.

Method 1.

As mentioned before and illustrated in Figure 7, an AL-PDU can contain an optional control field of 0,1 or 2 octets, a variable length AL-PDU payload field, and a CRC field for 16-bit CRC error detection. The control field contains a sequence number (SN) field, with the help of which the AL3 receiver may detect that a whole AL-PDU is missing or has been misdelivered by the MUX layer. In such a case the invented multiplexer will substitute detected missing packets by empty packets, and add thereto an error indication, e.g. PACKET_MISSING (not shown).

Method 2.

In HDLC any frame that ends with an all "1" bit sequence that is equal to or greater than seven bits in length will be ignored. Therefore, one method to abort a frame in HDLC is to transmit at least seven contiguous "1" bits. Anyhow, H.223 does not support this feature, and therefore a bit sequence of six or more "1" bits inside the packet indicates an obvious transmission error. In such a case the invented multiplexer will forward an error indication to the decoder, e.g. ILLEGAL_BIT_COMBINATION (not shown) and the location of bytes comprising excessive number of contiguous "1" bits.

10 Method 3.

Since the minimum difference between an HDLC flag and an acceptable bit combination is only one bit (e.g. 01111110 and 011110110), changing of one "0" bit to a "1" bit may cause a false flag to appear inside the packet. The MC field in a MUX-PDU header references an entry in the multiplex table, which discloses the logical information channels (audio, video etc.) of the packet and the size of different logical parts. Said size information, anyhow, is not necessarily correct, since the multiplexer at the transmission end may interrupt the transmission of a packet to multiplex some more urgent packets.

20 The flow chart of figure 8 illustrates an exemplary error detection method in this case. In case a flag is found (step 81), CRC is carried out for the following bits constituting the assumed header of the next MUX-PDU (step 82). If the header CRC succeeds (step 83), the flag is interpreted to be correct and no error indication is necessary. If the header CRC fails, the expected length of the packet is checked (step 84). If according to the header size information it seems that the packet should be longer (step 85), the invented multiplexer will forward the decoder an error indication, e.g. ILLEGAL_BIT_COMBINATION, and the location of the bytes carrying the false flag (step 86). In the example shown, CRC is used for header error detection. Other error detection types for use with other framing types are possible, as well.

Method 4.

As explained earlier, for certain logical channels, each MUX-SDU may be broken into segments and these segments may be transferred in one or more MUX-PDUs. The end of each MUX-SDU is marked by a one's complemented synchronization flag (H.223 annex B and C) or by a PM field in the MUX-PDU (H.223, H223 annex A). Specifically, when using PM field, it is set to "1" to indicate that the last octet of the previous MUX-PDU was the final octet of the terminating MUX-SDU. In all other circumstances the PM field is set to "0". Since the flag or the PM bit is not included in the header CRC, they add the probability of transmission errors

At the beginning of the session the terminals negotiate a maximum packet size for both the video and the audio packets. If the PM bit of some previous packet has been erroneous, or some closing flag of a preceding MUX-PDU is lost and some excessive data has been multiplexed to the packet, the amount of data in a received MUX-SDU may exceed said maximum. In such case the invented demultiplexer will store the segmentation points of the MUX-SDU, add an error indication, e.g. `CONCATENATED_PACKETS` (not shown) and indicate the location of segmentation points. With the help of this data, the decoder can try to locate the missing end point e.g. by searching for the possible start code which appears in the beginning of a video picture. The method can be further improved by arranging the demultiplexer to check the redundancy of a demultiplexed video signal using different combinations of received individual segments. If a correct starting (or ending) point is found, it will be forwarded to the decoder. If sequence numbering is used, the missing starting point can be searched from the beginning of segments. Even if the decoder does not find the end point, which is the case if the closing flag has been lost, it is usually worthwhile to try to utilize as much of the received data as possible, i.e. at least parts that correspond to the negotiated packet size.

Method 5.

The case when the amount of received data for a video packet falls below said negotiated maximum is often based on the fact that the video encoder has

stopped coding the packet for an allowable reason. However, it is also possible that a false flag may have appeared, or a PM bit may have been erroneously changed to another. If the packet has been erroneously cut, the bits at the end of the video packet are interpreted as CRC bytes and the CRC of the video packet will probably fail. To avoid such loss, the demultiplexer is adapted to forward the decoder an error indication, e.g. POSSIBLY_SHORT_PACKET (not shown) and the assumed CRC bytes at the end of the packet. The erroneousness of the short packet can be confirmed by checking whether the sequence number of the next packet supports the interpretation. If the decoder deems that the packet has been erroneously cut, it can interpret the CRC bits according to their original purpose and save the packet.

Method 6.

If a framing flag is lost due to transmission errors, a MUX-PDU from a sequence of segmented MUX-SDU will be missing. Also, if the header field fails the CRC, the MUX-PDU will be rejected. In such cases, the CRC of the MUX-SDU will probably indicate an error, since bytes from the lost MUX-PDU are missing from the MUX-SDU. The demultiplexer will be adapted to give the decoder an error indication, e.g. SEGMENT_MISSING (not shown) and the bytes of the location of the missing or rejected MUX-PDUs.

Method 7.

As mentioned earlier, additional "0" bits are added to the packet to avoid more than five consecutive "1" bits inside the packet. If due to a transmission error a "1" bit is changed to a "0" bit, the demultiplexer will not recognize the added "0" bit and will not extract it from the bit stream. Also, if due to a transmission error one "0" bit after four consecutive "1" bits is changed to a "1" bit, the next "0" bit will be removed unnecessarily. In both theses cases, the receiving side will lose the synchronization, and the following correctly received bits will be demultiplexed incorrectly.

A MUX-PDU consists of data units from different media sources (audio, video etc), and these kind of errors cause problems to the information packets in the end of MUX-PDUs. Usually, the MUX-PDU is headed by an audio packet, which comprises a CRC field. Since audio packets are generally not segmented, CRC of the audio data can be carried out directly after demultiplexing. In the invented method, if the CRC of the audio data fails, the timing of the MUX-PDU will be shifted by using bits from the end of the audio packet for the formation of a video packet, or by rejecting extra bits (assumed to be audio bits) from the beginning of the first byte. If any such shifting results in a successful CRC, the transmission error can be considered eliminated.

The principle of this method is illustrated in Figure 9, where line 90 represents the original packet comprising audio bytes 91, video bytes 92, and the flag 93. If the last byte of the video packet is too short and the audio CRC indicates an error, the error in the video packet can possibly be eliminated by shifting the beginning of the video data unit by bits 94 at the end of the audio packet or by bits 95 at the beginning of the video data unit. Actual bits do not necessarily have to be moved; it is sufficient to indicate the location of the shifted starting bit to the decoder. In such a case the demultiplexer is therefore adapted to add an error indication, e.g. SHIFTED_SEGMENT (not shown) and the beginning and end points of the shifted segment are counted from the beginning of the packet.

Method 8.

In case the last byte of a MUX-PDU is too short, but the situation described in method 7 is not observed, the MUX-PDU suffers from HDLC "0" bit error. If the video packet is segmented (which usually is the case) the possible error affecting the whole video packet can be located to said segment. In such a case the demultiplexer is adapted to add an error indication, e.g. CORRUPTED_SEGMENT (not shown) with the beginning and end points of said corrupted segments.

Some of the possible alternatives of the decoder for utilizing the error information forwarded by the demultiplexer have been discussed with relevant error detection method descriptions. The final algorithm for error recovery used by the decoder depends on the chosen combination of possible error indications, and will not be

5 further discussed here.

It is to be understood that the present invention may be embodied with other changes, improvements and modifications that may occur to those skilled in the art, without departing from the scope of the invention defined in the appended

10 claims.

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206

CLAIMS

1. A method in reception of a multiplex signal, comprising
one or more data units, including a video data unit, and
5 at least one framing data block in each multiplex signal, the framing data block carrying information on the configuration of the data units in said multiplex signal; the method comprising:
searching for said framing data block from a received multiplex signal;
demultiplexing said one or more data units according to the information in
10 said framing data block;
generating one or more demultiplexed signals, including a video data signal, from said demultiplexed data units,
forwarding said demultiplexed signals for decoding;
wherein:
15 detecting at demultiplexing a possible invalidity of a demultiplexed video data unit; and
adding, as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal.
- 20 2. A method according to claim 1, wherein further adding an estimation of the location of erroneous bytes to said error indication.
3. A method according to claim 1, wherein said framing data blocks comprise an HDLC flag.
- 25 4. A method according to claim 1, wherein said framing data blocks comprise a PN flag.
5. A method according to claim 1, wherein by said detection comprising checking
30 the validity of the sequence number of the AL-PDU.

6. A method according to claim 1, wherein said detection comprising checking for illegal bit combinations in the video data units.

7. A method according to claim 1, wherein said detection comprising checking the length of a demultiplexed signal; and as a response to an invalid length, indicating the segmentation points of the concatenated packets.

8. A method according to claim 1, wherein said detection comprising detecting errors in the length of a demultiplexed video signal.

9. A method according to claim 1, wherein said detection comprising detecting missing segments.

10. A method according to claim 1, wherein said detection comprising search for a shifted location of the starting point of a demultiplexed video signal.

11. A method according to claim 1, wherein said detection comprising checking for corrupted segments.

12. A device for demultiplexing a multiplex signal, comprising one or more data units, including a video data unit, and at least one framing data block in each multiplex signal, the framing data block carrying information on the configuration of the data units in said multiplex signal, said device comprising

means for searching for said framing data block in a received multiplex signal;

means for demultiplexing said one or more data units according to the information in said framing data block;

means for generating demultiplexed signals from said demultiplexed data units,

means for forwarding said demultiplexed signals for decoding;

wherein said device further comprises:

5

10

- 15

20

means for adding, as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal.

ABSTRACT

A method in reception of a multiplex signal, comprising one or more data units, and at least one framing data block in each multiplex signal. The method comprises: searching for said framing data block from a received multiplex signal; demultiplexing said one or more data units according to the information in said framing data block; generating one or more demultiplexed signals from said demultiplexed data units, and forwarding said demultiplexed signals for decoding (50). At multiplexing possible invalidity of demultiplexed video data units is detected (51), and as a response to a detected invalidity in a demultiplexed video data unit, an error indication to the demultiplexed video data signal is added (52).

(Fig 5)

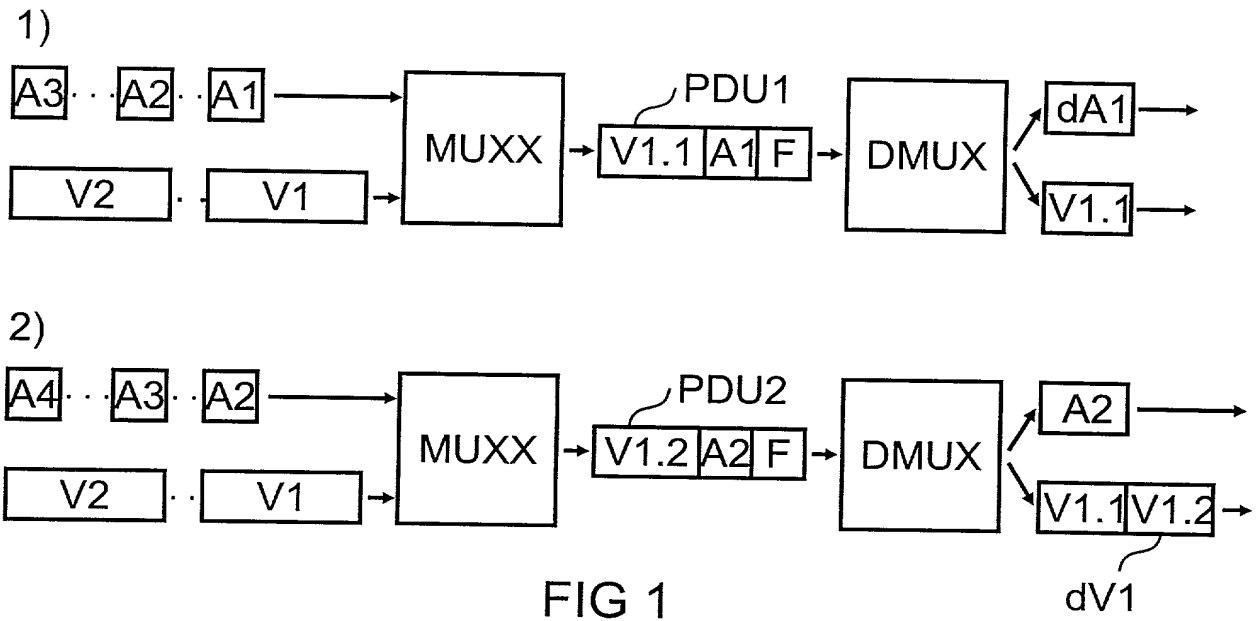


FIG 1

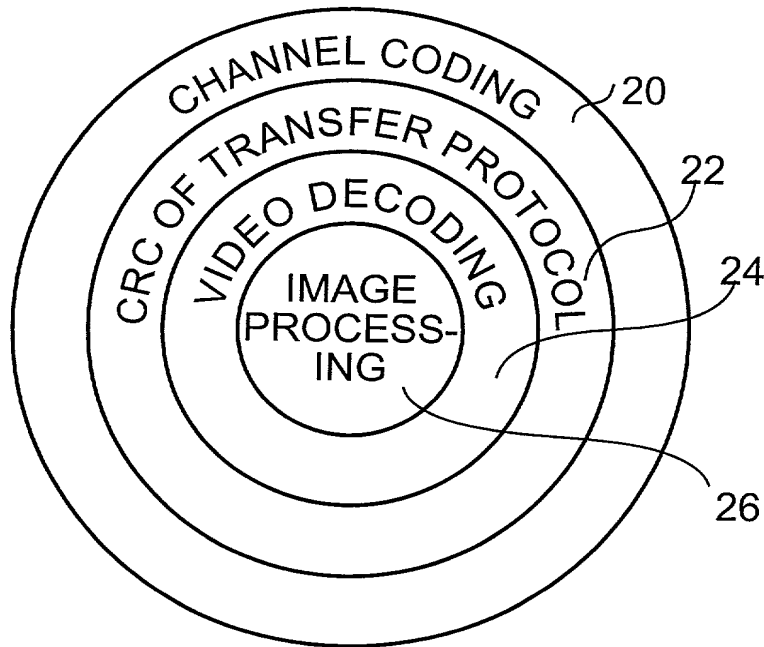


FIG 2

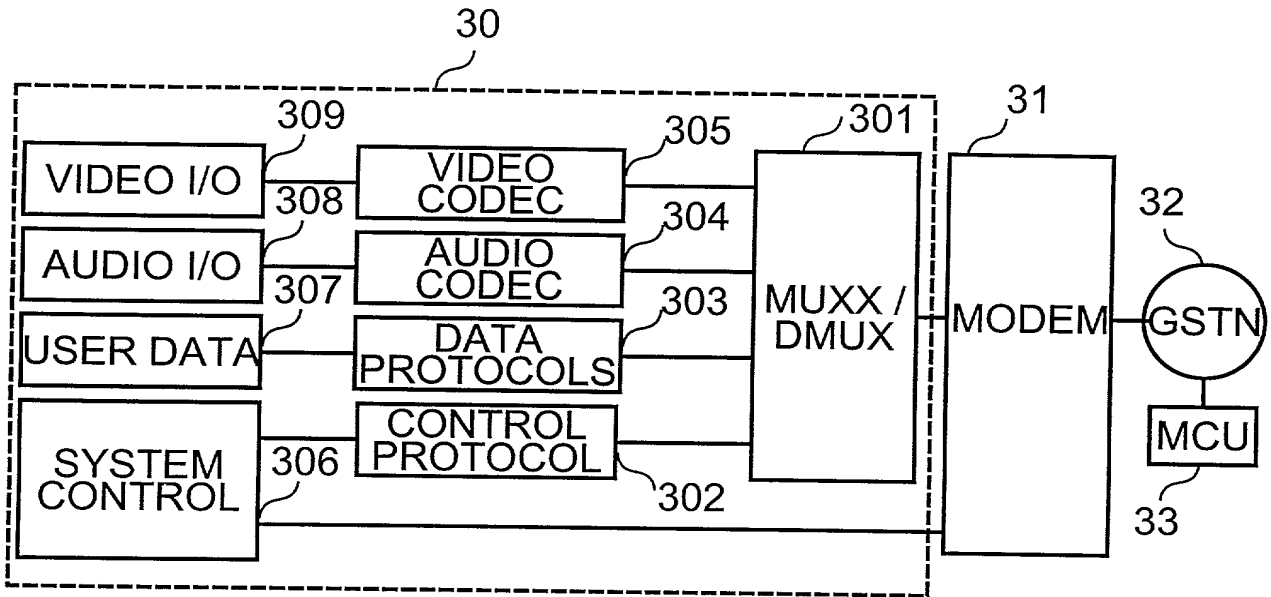


FIG 3

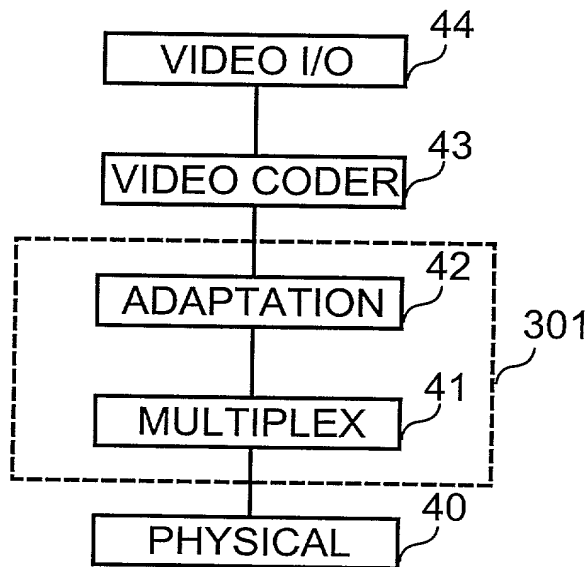


FIG 4

3/4

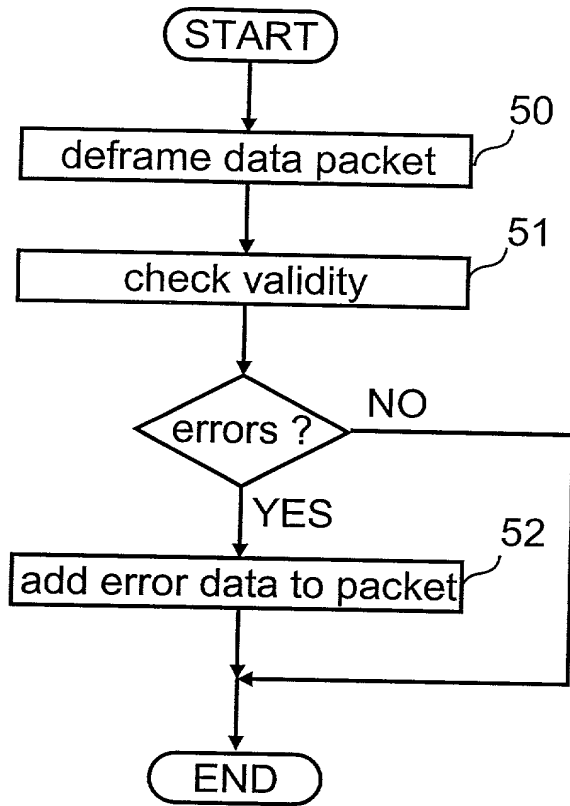


FIG 5

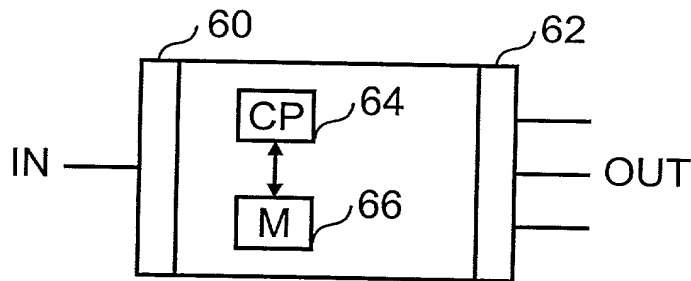


FIG 6

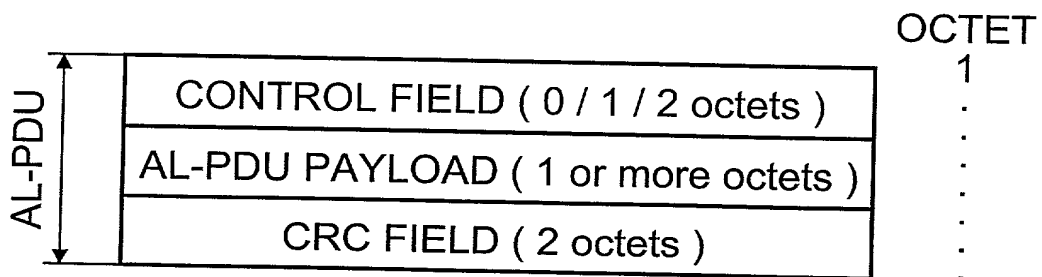


FIG 7

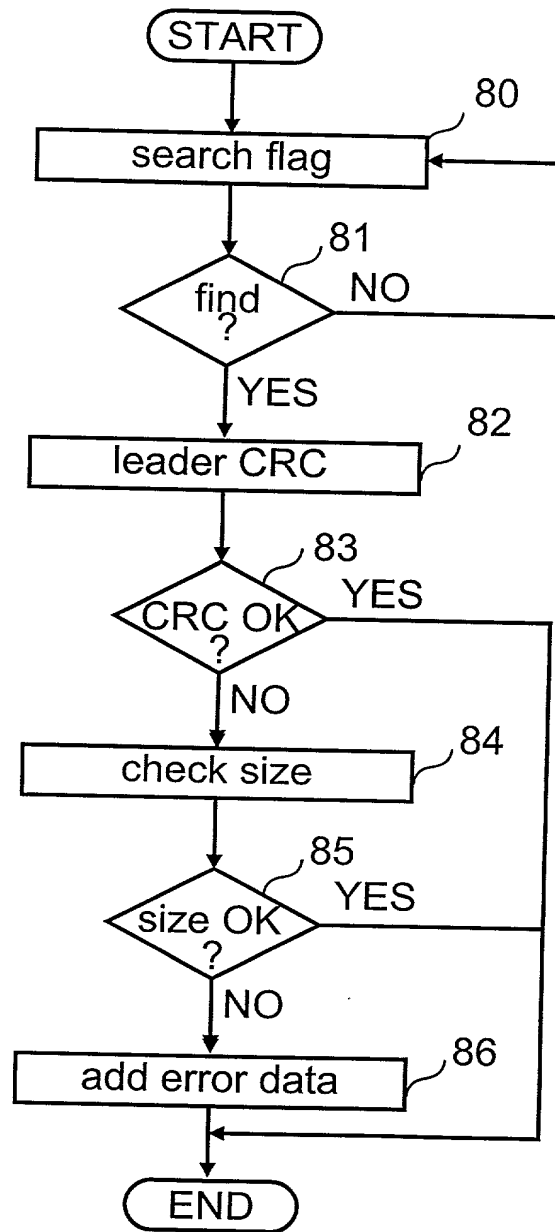


FIG 8

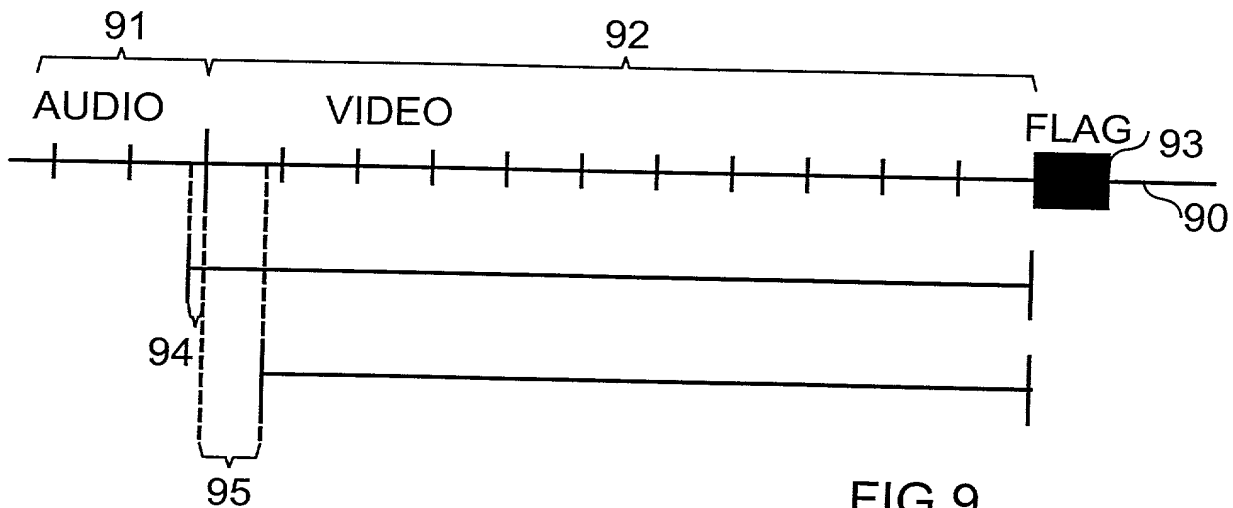


FIG 9

EAttorney's Docket No. _____

PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,
CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☒ original
☐ design
☐ supplemental

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

☐ national stage of PCT

NOTE: if one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

- ☐ divisional
☐ continuation
☐ continuation-in-part (C-I-P)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

Error detection in receiving multiplex signals

SPECIFICATION IDENTIFICATION

the specification of which: (complete (a), (b) or (c))

- (a) ☒ is attached hereto.
(b) ☐ was filed on _____ as ☐ Serial No. 0 /
or ☐ Express Mail No., as Serial No. not yet known
and was amended on _____ (if applicable)

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

- (c) ☐ was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____ (if any).

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information

- ☒ which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56
(also check the following items, if desired)

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ In compliance with this duty there is attached an information disclosure statement in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT International application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

- (d) ☐ no such applications have been filed.
(e) ☒ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**A. PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Finland	981507	30 June 1998	<input checked="" type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6) MONTHS FOR DESIGN PRIOR TO THIS U.S. APPLICATION**

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(List name and registration number)*

Clarence A. Green (24,622)
Harry F. Smith (32,493)
Mark F. Harrington (31,686)

(check the following item, if applicable)

- ☐ Attached as part of this declaration and power of attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

Perman & Green
425 Post Road
Fairfield, CT 06430-6232

DIRECT TELEPHONE CALLS TO:

(Name and telephone number)
Mark F. Harrington

(203) 259-1800

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Ari

(GIVEN NAME)

J

(MIDDLE INITIAL OR NAME)

Hourunranta

FAMILY (OR LAST NAME)

Inventor's signature

Date 20th May 1999 Country of Citizenship Finland

Residence Lindforsinkatu 17 A 23, FIN-33720 Tampere, Finland

Post Office Address Lindforsinkatu 17 A 23, FIN-33720 Tampere, Finland

NEULASKATU 3 B 27

33820

20th May 1999 AH

Full name of second joint inventor, if any

Miska

(GIVEN NAME)

M

(MIDDLE INITIAL OR NAME)

Hannuksela

FAMILY (OR LAST NAME)

Inventor's signature

Date 21st May 1999 Country of Citizenship Finland

Residence Kukkanitiynkatu 4 B, FIN-33710 Tampere, Finland

Post Office Address Kukkanitiynkatu 4 B, FIN-33710 Tampere, Finland

Full name of third joint inventor, if any

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

CHECK PROPER BOX(ES) FOR ANY OF THE FOLLOWING ADDED PAGE(S) WHICH FORM
A PART OF THIS DECLARATION

- ☐ Signature for fourth and subsequent joint inventors. *Number of pages added*
...
- ☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or
incapacitated inventor. *Number of pages added*
...
- ☐ Signature for inventor who refuses to sign or cannot be reached by person authorised under
37 CFR 1.47. *Number of pages added*
...
- ☐ Added page for signature by one joint inventor on behalf of deceased inventor(s)
where legal representative cannot be appointed in time (37 CFR 1.47).
...
- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or
continuation-in-part (C-I-P) application. ☐ Number of pages added
...
- ☐ Authorization of attorney(s) to accept and follow instructions from representative.
...

(If no further pages form a part of this Declaration, then end this Declaration with this page and
check the following item:)

☒ This declaration ends with this page.

(Declaration and Power of Attorney [1-1]-page 5 of 5)